RESEARCH PROPOSAL

A Study on Statistical Techniques In Deep Learning

A synopsis submitted to

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Title of the Research Topic:
"A Study on Statistical Techniques In Deep Learning"

1. **Abstract:**

In the 21st century, crimes are continues increases in the various field viz., for the purpose of crime study we must require some tools like face detection, voice detection etc. The aim of the study, to develop new model using various deep learning technique for the facial recognition, voice recognition, financial services, health care, virtual personal assistants, predictions, computer vision /videos surveillance, social media services, email spam and malware filtering, online customer support, product recommendations online fraud detection biometrics etc. [1, 2]. Deep learning is challenging because it involves the embodiment of complex patterns the idea that breaking up complex knowledge into discrete pieces makes it easy to teach, but difficult to integrate, embody, and apply. It provides a conceptualization of deep learning, the deep learning; new knowledge and skills become a natural part of self as they are integrated into existing mental structures. The experience of deep learning is one of a flow state fully immersed inactivity.

Deep learning has evolved hand-in-hand with the digital era, which has brought about an explosion of data in all forms and from every region of the world. This data, known simply as big data, is drawn from sources like social media, internet search engines, e-commerce platforms, and online cinemas, among others. This enormous amount of data is readily accessible and can be shared through fintech applications like cloud computing. However, the data, which normally is unstructured, is so vast that it could take decades for humans to comprehend it and extract relevant information. Companies realize the incredible potential that can result from unraveling this wealth of information and are increasingly adapting to AI systems for automated support.

The synopsis aims to understand the important concepts related to the research topic.

2. Introduction

Since 2006, deep structured learning, or more commonly called deep learning or hierarchical learning, has emerged as a new area of machine learning research [9, 19]. During the past several years, the techniques developed from deep learning research have already been impacting a wide range of signal and information processing work within the traditional and the new, widened scopes including key aspects of machine learning and artificial intelligence. A class of machine learning techniques that exploit many layers of non-linear information processing supervised or unsupervised feature extraction and transformation, and for pattern analysis and classification. Deep learning is sub-field within machine learning that is based on algorithms for learning multiple levels of representation in order to model complex relationships among data. Higher-level features and concepts are thus defined in terms of lower-level ones, and such a hierarchy of features is called a deep architecture. Most of these models are based on unsupervised learning of representations. Deep learning is a set of algorithms in machine learning that attempt to learn in multiple levels, corresponding to different levels of abstraction. It typically uses artificial neural networks. The levels in these learned statistical models correspond to distinct levels of concepts, where higher-level concepts are defined from lower-level ones, and the same lower level concepts can help to define many higher-level concepts[11,14]. Deep Learning is a new area of Machine Learning research, which has been introduced with the objective of moving Machine Learning closer to one of its original goals: Artificial Intelligence. Deep Learning is about learning multiple levels of representation and abstraction that help to make sense of data such as images, sound, and text [7].

Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction. These methods have dramatically improved the state-of-the-art in speech recognition, visual object recognition, object detection and many other domains such as drug discovery and genomics. Deep learning discovers intricate structure in large data sets by using the back-propagation algorithm to indicate how a machine should change its internal parameters that are used to compute the representation in each layer from the representation in the previous layer. Deep convolution nets have brought about breakthroughs in processing images,

video, speech and audio, whereas recurrent nets have shown light on sequential data such as text and speech [8].

2. Review of Literature and Development in the subject.

Gal et al. [6] observed that deep learning poses several difficulties when used in an active learning setting. They combine recent advances in Bayesian deep learning into the active learning framework in a practical way. In their study, author demonstrates active learning techniques with image data, and obtained a significant improvement on existing active learning approaches. Dubey et al. [4] studied Computer vision methods that quantify the perception of urban environment are increasingly being used to study the relationship between a city's physical appearance and the behavior and health of its residents. They train a Siamese-like convolution neural architecture, which learns from a joint classification and ranking loss, to predict human judgments of pair-wise image comparisons. Their results show that crowd sourcing combined with neural networks can produce urban perception data at the global scale. Denil et al. [3] demonstrated that there is significant redundancy in the parameterization of several deep learning models. Few of the weight values are given for each feature to accurately predict the remaining values. Moreover, they show that not only can the parameter values be predicted, but many of them need not be learned at all. In the best case they were able to predict more than 95% of the weights of a network without any drop in accuracy. The idea is orthogonal but complementary to recent advances in deep learning, such as dropout, rectified units and maxout. It creates many avenues for future work, such as improving large scale industrial implementations of deep networks, but also brings into question whether we have the right parameterizations in deep learning.

Yin et al. [20] proposed deep learning approach for intrusion detection using recurrent neural networks. They studied the performance of the model in binary classification and multiclass classification, and the number of neurons and different learning rate impacts on the performance of the proposed model. Moreover, compare it with those of artificial neural network, random forest, support vector machine, and other machine learning methods proposed by previous researchers on the benchmark data set. The result of their study showed that, RNN-IDS is very suitable for modeling a classification model with high accuracy and that its performance is superior to that of traditional machine learning classification methods in both binary and multiclass classification. The RNN-IDS model improves the accuracy of the intrusion detection and provides a new research method for intrusion detection. Gal and Ghahramani [5] used the rich Bayesian statistics literature with deep learning models, explain away many of the curiosities with these, combine results from deep learning into Bayesian modeling, and much more. They exhibits the practical impact of the framework with image classification by combining Bayesian and deep learning techniques, obtaining new state-of-the-art results, and survey open problems to research. These stand at the forefront of a new and exciting field combining modern deep learning and Bayesian techniques. They presented new theoretical developments casting modern deep learning techniques as approximate variational inference, and demonstrated the impact of the theory through an application in image classification. Mhaskar et al. [10] demonstrates how deep learning can outperform shallow networks. The prediction of blood glucose levels based on continuous glucose monitoring system data 30min ahead is a very important problem with many consequences for the health care industry. They suggested a deep learning paradigm based on a solid mathematical theory as well as domain knowledge to solve this problem accurately as assessed by the PRED-EGA grid, developed specifically for this purpose. Thus, the blessing of compositionality cures the curse of dimensionality. However, the compositional structure is not unique, and it is open problem to decide whether a given target function has a certain compositional structure. Moreover, domain knowledge of deep learning can be used to build an appropriate compositional structure, leading to a parsimonious deep learning design.

❖ **Scope of the Study:**

The framework of new and exciting field of study combines modern deep learning and Bayesian techniques in a practical way. Many open problems arise within it, and here we survey directions for future research.

1. Deep learning can be extended in a principle way. Understanding the underlying principles leading to good models allows us to improve upon them. These can range from simple distributions to complex ones, tying different parameters to force correlations between the weights.
2. Deep learning uncertainty to study different nonlinearity regularization combinations correspond to different Gaussian process covariance functions and these have different characteristics in terms of the predictive uncertainty.
3. Deep learning can make use of Bayesian models. A much more interesting application of the theory is the combination of techniques from the two fields: deep learning and Bayesian modeling.
4. Bayesian models can make use of deep learning and can give benefit immensely from the simple data representations obtained from deep learning models. Sequence data, image data, high dimensional data – these are structures that traditional Bayesian techniques find difficult to handle. By using deep learning techniques, we can combine these easily and in a principled way.
5. Unsupervised deep learning: Bayesian statistics lends itself naturally to data analysis and unsupervised data modeling. With the Bayesian interpretation of modern deep learning tools new horizons open and new tools become available to solve this laborious task.
6. Natural language understanding is another area in which deep learning is poised to make a large impact over the next few years. We expect systems that use RNNs to understand sentences or whole documents will become much better when they learn strategies for selectively attending to one part at a time.
7. Major progress in artificial intelligence will come about through systems that combine representation learning with complex reasoning. Although deep learning and simple reasoning have been used for speech and handwriting recognition for a long time, new paradigms are needed to replace rule-based manipulation of symbolic expressions by operations on large vectors.

4. Objectives of the Research

Some of the proposed objectives of the research are:

1. Analytical study of predictive techniques used in deep learning.
2. To perform comparative study of most common predictive techniques used in deep learning.
3. To construct prediction models using various deep learning techniques.
4. To validation of the developed model for various kind of date-sets.
5. To find application of various predictive techniques in deep learning.
6. To find out the best predictive technique in deep learning according to their applications.

During the period of research many new objectives may be developed which will be beneficial for the society.

5. Methodology:

Automatic face recognition in unconstrained environments is a popular and challenging research problem. With the improvements in recognition algorithms, focus has shifted from addressing various covariates individually to performing face recognition in truly unconstrained scenarios. Face databases such as the YouTube Faces and the Point-and-shoot-challenge capture a wide array of challenges such as pose, expression, illumination, resolution, and occlusion simultaneously. In general, every face recognition algorithm relies on some form of feature extraction mechanism to succinctly represent the most important characteristics of face images so that machine learning techniques can successfully distinguish face images of one individual apart from those of others.

A deep machine learning process consists of two main phases: training and inferring. In the training phase, the process of labeling is used for large amount of data and determining their matching characteristics. The system compares these characteristics and memorizes them to make correct conclusions when it faces similar data next time.

A deep learning training process includes following stages:

1. ANNs ask a set of binary false/true questions or.
2. Extracting numerical values from data blocks.
3. Classifying data according to the answers received.
4. Labeling Data.

During the inferring phase, the deep learning AI makes conclusions and label new unexposed data using their previous knowledge. Also, one can improve supervised learning for deep architectures if one jointly learns an embedding task using unlabeled data. Researchers using shallow architectures already showed two ways of using embedding to improve generalization: (i) embedding unlabeled data as a separate preprocessing step (i.e., first layer training) and; (ii) using embedding as a regularized (i.e., at the output layer.)

6. **Importance of Study/Society application:**

- **International Status**:

Razzak et al. [13] observed that, image interpretation by human expert it is quite limited due to its subjectivity, complexity of the image, extensive variations exist across different interpreters, and fatigue. After the success of deep learning in other real world application, it is also providing exciting solutions with good accuracy for medical imaging and is seen as a key method for future applications in health sector. Also, state of the art deep learning architecture and its optimization used for medical image segmentation and classification. They also discussed the challenges in deep learning based methods for medical imaging and open research issue. So far deep learning based application provided positive feedback, however, but due to the sensitivity of healthcare data and challenges, one should look more sophisticated deep learning methods that can deal complex healthcare data efficiently.

Taylor et al. [17] introduced a simple and effective deep learning approach to automatically generate natural looking speech animation that synchronizes to input speech. Their approach uses a sliding window predictor that learns arbitrary nonlinear mappings from phoneme label input sequences to mouth movements in a way that accurately captures natural motion and visual co articulation effects. They developed an effective approach for speech animation that can be easily integrated into existing production pipelines. They provide a detailed description of end-to-end approach, including machine learning design decisions. Generalized speech animation results are demonstrated over a wide range of animation clips on a variety of characters and voices, including singing and foreign language input. Finally, they generate on-demand speech animation in real-time from user speech input.

Deep and recurrent neural networks (DNNs and RNNs) are powerful models that were considered to be almost impossible to train using stochastic gradient descent with momentum. Sutskever [15] demonstrated that, when stochastic gradient descent with momentum uses a well-designed random initialization and a particular type of slowly increasing schedule for the momentum parameter, it can train both DNNs and RNNs (on datasets with long-term dependencies) to levels of performance that were previously achievable only with Hessian-Free optimization. They find that both the initialization and the momentum are crucial since poorly initialized networks cannot be trained with momentum and well-initialized networks perform markedly worse when the momentum is absent or poorly tuned. Result of their study reveals that, previous attempts to train deep and recurrent neural networks from random initializations have likely failed due to poor initialization schemes. Furthermore, carefully tuned momentum methods suffice for dealing with the curvature issues in deep and recurrent network training objectives without the need for sophisticated second-order methods.

- **National Status:**

Raman et al. [12] used Fundus photograph-based deep learning algorithms for detecting diabetic retinopathy. Remarkable advances in biomedical research have led to the generation of large amounts of data. Using artificial intelligence, it has become possible to extract meaningful information from large volumes of data, in a shorter frame of time, with very less human interference. In effect, convolution neural networks (a deep learning method) have been taught to recognize pathological lesions from images. Deep neural networks offer a great advantage of screening for DR from retinal images, in improved identification of DR lesions and risk factors for diseases, with high accuracy and reliability. Results of their study revealed that deep learning has shown impressive results of high sensitivity and specificity in automated image analysis of fundus photographs. Artificial intelligence

would act as an auxiliary part and a useful assistant in DR screening and provide diagnostic support and cannot replace the role of ophthalmologists in clinical diagnosis and management.

Thenmozhi et. al. [18] proposed deep learning approach to named entity recognition and relation extraction for conversational systems in Indian languages. Named Entity Recognition (NER) focuses on the classification of proper nouns into the generic named entities (NE) such as person names, organizations, locations, currency and dates. Relation Extraction (RE) is an information extraction process used to identify the relationship between NEs. Further, developing language independent framework that supports all Indian Languages is a challenging task. They presented a deep learning methodology for both NER and RE in five Indian languages namely Hindi, Kannada, Malayalam, Tamil and Telugu. They proposed a common approach that works for both NER and RE tasks.

- **Significance of the study**

Now a days, to solve real life problems, it is essential to deal with advanced techniques for analysis and to check the significance, efficiency of the results with the scientific statistical tool and existing and new deep learning techniques with SPSS, R, PYTHON, MATLAB and MINITAB etc. software to optimize it.

7. **Proposed work Plan/ Formulation and Structure of Study:**

Year wise Plan of work and targets to be achieved

- **First Year**
  1. To collect and study of review of literature of deep learning techniques.
  2. Collection and Study of different deep learning data sets.
  3. Study of different Software packages.
- **Second Year**
  1. Try to develop statistical model for deep learning.
  2. Selection of one of the standard datasets for application of deep learning Predictive Statistical techniques for comparison of results obtained.
  3. Detailed study and collaborative analysis of the results obtained.
  4. The comparative study of the use of different deep learning Software packages for the same data sets.
- **Third Year**
  1. The publication of the findings of the research.
  2. Publication of papers in various national and international journals & conferences.
  3. Thesis writing.

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